REMARKS

Prior to the present amendment and response, claims 93-101, 104-113, and 116-117 were pending in the present application. By the present amendment and response, claims 93 and 105 have been amended to overcome the Examiner's objections and new claims 118 and 119 have been added. New claim 118 is the independent form of claim 100, which includes all of the limitations of base claim 93, while new claim 119 corresponds to dependent claim 101. New claims 118 and 119 are thus allowable according to the Examiner's comments on page 7 of the Office Action dated February 8, 2005. Thus, claims 93-101, 104-113, and 116-119 remain in the present application and claims 118-119 are now in condition for allowance. Reconsideration and allowance of outstanding claims 93-101, 104-113, and 116-117 in view of the above amendments and the following remarks are requested.

A. Rejections of Claims 93-99, 104-109, and 116-117 under 35 USC §103(a)

The Examiner has rejected claims 93-99, 104-109, and 116-117 under 35 USC §103(a) as being obvious with respect to U.S. patent number 5,792,706 to Michael, et al. (hereinafter "Michael") in view of U.S. patent number 6,040,248 to Chen, et al. (hereinafter "Chen") and U.S. patent number 6,017,814 to Grill, et al. (hereinafter "Grill"). For the reasons discussed below, Applicant respectfully submits that the present

invention, as defined by amended independent claims 93 and 105, is patentably distinguishable over Michael, Chen, and Grill, singly or in any combination thereof.

The present invention, as defined by amended independent claims 93 and 105, recites, among other things, forming a first air gap, a second air gap, and a support pillar in a first hard mask, and depositing a sealing layer over the first hard mask, and a first insulating layer, where the first insulating layer and the sealing layer comprise a same low dielectric constant material. As disclosed in the present application, a first insulating layer, which is formed between interconnect lines, and a sealing layer, which is formed over the first insulating layer and a first hard mask, can comprise a low dielectric constant material. By utilizing a low dielectric constant material to form the first insulating layer and the sealing layer, the present invention can advantageously achieve an interconnect structure having reduced intra-layer and inter-layer capacitance. For example, the low dielectric constant material can be doped SiO_2, silsesquioxanes, polyimides, fluorinated-polyimides, parylene, fluoro-polymers, poly(arylethers), fluorinated-poly(arylethers), porous-polymer/polyimide, polytetrafluoroethyulene, or porous silica.

Furthermore, as disclosed in the present application, when the sealing layer (e.g. sealing layer 26) is made from the same material as the first insulating layer (e.g. dielectric layer 18), the etch chemistry does not need to be changed when etching a via hole in the sealing layer and the first insulating layer. Page 11, lines 22-25 of the present application. Thus, by forming a sealing layer and a first insulating layer of the same low dielectric constant material, the present invention advantageously achieves an

interconnect structure having reduced intra-layer and inter-layer capacitance and a reduce in process steps.

In contrast to the present invention as defined by amended independent claims 93 and 105, Michael does not teach, disclose, or suggest forming a first air gap, a second air gap, and a support pillar in a first hard mask, and depositing a sealing layer over the first hard mask, and a first insulating layer, where the first insulating layer and the sealing layer comprise a same low dielectric constant material. Michael specifically discloses first dielectric 20 formed over and between adjacent lines 11, where first dielectric 20 is preferably a TEOS based oxide for improved step coverage and conformality. See, for example, column 5, lines 51-61 and Figure 3 of Michael. In Michael, capping dielectric layer 30, which comprises a layer of silicon dioxide formed from a silane source in a low temperature, atmospheric pressure chemical vapor deposition (CVD), is formed on first dielectric 20. See, for example, Michael, column 6, lines 57-61.

Michael states that TEOS based oxides are better able to fill spaces between adjacent lines 11 than silane based oxides since silane based oxides tend to leave voids when used to fill spaces having aspect ratios greater than 0.5. See, for example, Michael, column 5, lines 56-61. However, Michael fails to teach, disclose, or remotely suggest a first insulating layer and a sealing layer that comprise the same low dielectric constant material, as specified in amended independent claims 93 and 105. In fact, Michael fails to teach, disclose, or suggest using a low dielectric constant material to form a first insulating layer and a sealing layer. Moreover, Michael utilizes different dialectic

materials for first dielectric 20 and capping dielectric layer 30. Thus, Michael does not require that the first dielectric 20 and capping dielectric layer 30 comprise the same dielectric material.

In contrast to the present invention as defined by amended independent claims 93 and 105, Chen does not teach, disclose, or suggest forming a first air gap, a second air gap, and a support pillar in a first hard mask, and depositing a sealing layer over the first hard mask, and a first insulating layer, where the first insulating layer and the sealing layer comprise a same low dielectric constant material. Chen discloses various organic insulators such as siloxanes, aerogels, and xerogels have been successively used as low dielectric constant replacements for silicon oxide. See, for example, Chen, column 1, lines 37-40. However, Chen fails to teach, disclose, or suggest a first insulating layer and a sealing layer comprising the same low dielectric constant material, as specified in amended independent claims 93 and 105.

Furthermore, the requirements for an insulating layer are different than the requirements for a sealing layer. For example, in Michael, TEOS oxide is used for first dielectric 20 for improved step coverage and conformality, while a silane based oxide is used for capping dielectric 30 to produce cusping that serves to seal off upper portion of trenches without filling the trenches with dielectric material. See, for example, Michael, column 5, lines 56-59 and column 6, lines 57-66. Thus, Applicant respectfully submits that the combination of Michael and Chen suggested by the Examiner does not and

cannot result in the claimed invention. Thus, Chen fails to cure the basic deficiencies of Michael discussed above.

In contrast to the present invention as defined by amended independent claims 93 and 105, Grill does not teach, disclose, or suggest forming a first air gap, a second air gap, and a support pillar in a first hard mask, and depositing a sealing layer over the first hard mask, and a first insulating layer, where the first insulating layer and the sealing layer comprise a same low dielectric constant material. Grill specifically discloses structured dielectric layer 1 including bottom component 3, dielectric features 4, and top component 6, where dielectric features 4 might be SiO_2 lines. See, for example, column 2, lines 44-52 and Figure 1 of Grill. However, Grill fails to teach, disclose, or remotely suggest a first insulating layer and a sealing layer comprising the same low dielectric constant material, as specified in amended independent claims 93 and 105. Thus, Grill in combination with Chen fails to cure the basic deficiencies of Michael discussed above.

For all the foregoing reasons, Applicant respectfully submits that the present invention, as defined by amended independent claims 93 and 105, is not suggested, disclosed, or taught by Micheal, Chen, and Grill, singly or in any combination thereof. Thus, amended independent claims 93 and 105 are patentably distinguishable over Micheal, Chen, and Grill and, as such, claims 94-101 and 104 depending from amended independent claim 93 and claims 106-113 and 116-117 depending from amended independent claim 105 are, *a fortiori*, also patentably distinguishable over Micheal, Chen,

and Grill for at least the reasons presented above and also for additional limitations contained in each dependent claim.

B. **Conclusion**

Based on the foregoing reasons, the present invention, as defined by amended independent claims 93 and 105, and the claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. Thus, dependent claims 94-101, 104, 106-113, and 116-117 are also patentably distinguishable over the art cited by the Examiner. For all the foregoing reasons, an early allowance of outstanding claims 93-101, 104-113, and 116-117 and an early Notice of Allowance for all pending claims 93-101, 104-113, and 116-119 is respectfully requested.

Attorney Docket No.: 02SPE118P-DIV

Respectfully Submitted,
FARJAMI & FARJAMI LLP

Date: 5/2/05

Michael Farjami, Esq.
Reg. No. 38, 135

FARJAMI & FARJAMI LLP
26522 La Alameda Ave., Suite 360
Mission Viejo, California 92691
Telephone: (949) 282-1000
Facsimile: (949) 282-1002

CERTIFICATE OF FACSIMILE TRANSMISSION
I hereby certify that this correspondence is being filed by facsimile transmission to United States Patent and Trademark Office at facsimile number **703-872-9306** on the date stated below. The facsimile transmission report indicated that the facsimile transmission was successful.

Date of Facsimile: 5/2/05

Christina L. Carter
Name of Person Performing Facsimile Transmission

Signature Date 5/2/05

CERTIFICATE OF MAILING
I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

Date of Deposit:

Name of Person Mailing Paper and/or Fee

Signature Date